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# USE OF BULLDOZERS IN CONSTRUCTION OF A NARROW-GAUGE RAILROAD

I. N. Podol'skiy

Timber industry enterprises, especially established to be served by narrow- as well as wide-gauge railroads, are not fulfilling their plans because the roads are not being built quickly enough. Timber supplies accumulate, and locomotives stand idle.

The timber industry is receiving more bulldozers, and it will be able more speedily to build roads on which to send trains into timber regions throughout the year. The transport network will serve a large timber area regardless of the topography.

This article will discuss use of the bulldozer in construction of forest roads.

Bulldozers were used for road construction by the Konetsgorskiy Administration of the Dvinoles Trust. The experience gained in their use will be described in this article.

## 1 Forest Clearing

Bulldozers were used to fell trees on the planned 40-meter wide route of a narrow-gauge road. One bulldozer felled and uprooted trees on the right side of the route, clearing a swath 20 meters wide. A second bulldozer did the same on the left side of the route. A 50 - 70 meter interval was maintained between the dozers.

If the growth along the route had an average diameter of up to 20 centimeters, the felling and uprooting was done in the following manner. The operator directed the machine toward a tree or group of trees, hoisted the blade as high as possible, and then gently set the cutting edge against the tree. With one hand he held the hoisting lever, with the other he put the machine in gear, and gunned the motor, thus loosening the tree. If the tree inclined forward quickly, the operator shifted his lever into reverse.

In falling, the tree forcefully tears its roots out of the ground. The operator pulls the machine back so that the roots will be in front of him. He then lowers the blade, shifts into first gear, and pushes the tree off to the side. The bulldozer operator constantly regulates the height of the blade with the hand lever. If the blade should slide up over a root system or other felled debris, the bulldozer should be brought to an immediate halt. After reversing a short distance, approach should be made which would pick up the load from a better position.



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When the growth has an average diameter at chest height of more than 20 centimeters, the operator tries to uproot the trees at an angle of 45 degrees to the level of the road. He does not necessarily take the trees out individually, but as many as the variety and thickness of the tree and the root system permit. He then approaches the tree crosswise and pushes it to the side.

To uproot heavy trees with diameters up to 60 centimeters, loosening of the tree is done not with the center part of the blade but with the tip which is more sturdy and rigid. If the tree cannot be pushed over, a corner of the blade should be used to undercut it from one or two sides. This operation cuts a part of the roots and the tree falls.

Bulldozer operators should remember that heavy trees have large and extensive root systems. Such trees fall to the ground with great force and pull the large root system to the surface. If the operator does not back up quickly while the tree is falling, the roots may catch under the blade and lift the bulldozer up into the air, so that it cannot free itself. In such a situation, a second tractor moves up to the "caught" tractor and pulls the latter loose with a cable. If the "caught" tractor drags the tree along with it, the free bulldozer must then push the tree out from under the blade with its own blade.

If there is no second tractor, the fallen tree must be sawed off as close as possible to the blade. Then a second cut should be made about a half or full meter from the first and the sawed out portion of the tree removed. The tractor should then be moved forward and backward, and turned to the right or left, until the blade is free.

In uprooting trees, the operator must carefully watch the direction in which the tree is falling, especially in dealing with spruce. Under no circumstances is the tree to be allowed to fall on the tractor.

In route clearing, the work of one more worker is required. This worker carefully measures the route, sees to the stakes, markers, angles of turn, etc.

2. Uprooting Stumps and Brush Clearing

Uprooting stumps is done the same as felling trees with regard to diameter and species of stump. If the diameter of the stumps does not exceed 20 centimeters, uprooting may be done singly or several stumps at a time.

The method is the same as in felling. The tractor operator moves his machine up to the stump, raises the blade high enough so that the colter can catch the stump at or just above the root, a position from which the colter will be unable to slip. Then, the operator applies even pressure to the stump. The motor speed is increased and the stump begins to loosen. As soon as the stump is torn out of the ground, the operator reverses, drops the blade, and pushes the stump away.

The stump may break off and its roots remain in the ground. In that case, the root is dug out with a corner of the colter. Uprooting stump of a diameter greater than 20 centimeters is done at an angle, as with that size tree.

In areas to be cleared after trees have been cut down, it is desirable to leave stumps about one meter high. In general, it is twice as easy to uproot trees as stumps, because the weight of the trunk facilitates loosening the roots. Most stumps have to be uprooted by first undercutting them. Pushing away the fallen debris is an easy task for the tractor.

There were places on the route where there was a great deal of windfall. When a tractor accumulated too heavy a pile of windfall, a second tractor moved up and both tractors acting together pushed the enormous pile away.

Neither felling of trees nor uprooting of stumps should be attempted with a speeding tractor. Too much speed causes the blade or cable to break, splits the tree trunk, or causes some other undesirable result. Any of these eventualities would harm the machine or cause an unfortunate accident.

Brush cutting presents no difficulties. The operator lowers the blade so that it cuts the brush at a depth of 10 - 15 centimeters below the ground. The roots which the blade encounters do not halt the tractor. The operator constantly regulates the position of the blade so that it will not cut too deeply into the earth. As soon as the load has been pushed beyond the limits of the route, the operator repeats the operation.

3. Moving Earth for Railroad Embankments

After the route of the railroad bed has been cleared by a bulldozer, it is cleaned of all vegetation and debris. The soil now contains no obstructive bodies and can be utilized for construction of the bed.

Bulldozers are used in the following manner: a foreman, using a theodolite or estimating by sight, carefully marks the axis of the road with markers set every 10 - 20 meters. Pencil notations, such as N - 1.20 or N - 0.35 which signify that the embankment is to be 1.20 or 0.35 meters high, are made on the markers. Perpendicular to the axis of the route, additional stakes are set as guides for the tractor operator. Each stake has a number and also a notation of the height of the bed. When the boundary lines have been determined, the bulldozer operator takes careful note of the stakes learns the height of the bed, and sets to work.

The earth is taken in equal amounts from the sides of the cleared route by bulldozers working from both sides simultaneously. Both pick up earth from the edges of the route and build up an embankment along the axis of the route. After several of the stakes have been passed, one of the bulldozers drives up onto and along the embankment. It tamps the bed and levels the surface for 3 meters, the width of its blade. The bulldozer moves up and down the bed several times until the embankment attains the predetermined height. The bulldozer makes the final scraping in reverse with the blade lowered.

A skilled workman or foreman checks the bed height with ranging rods, making three sightings. If additional filling is required, a second bulldozer does it. It is also well to check the bed with a leveling instrument.

Not every bulldozer operator can do a good job in leveling the earthen embankment along the axis of the route. This job is usually done by a highly experienced operator, who is able to determine visually what to do and where to do it. Bulldozer operator Peter Tereshin proved himself an expert in this work.

Sometimes spots are encountered where it is impossible to carry out the leveling operation immediately, because of the moisture in the ground. In such a case, it is better to wait a day or two until the bed has dried out somewhat.

When an embankment had to be made as high as 6 meters, the deposit of earth onto the center was made at a 45-degree angle. But, the tractor pushed its load just as easily as it did to a height of one meter.

When two tractors are working together and the earth has to be brought up from a distance of 50 meters, the tractors work side by side, one-half meter apart. Thus, a natural strip of earth one-half meter wide remains between them. This method prevents the earth from being lost on the sides and permits bigger loads to be carried over the 50-meter distance. The strips of earth are picked up later, when the excavation has reached the depth planned to provide a sufficient volume of earth.

If the distance the earth has to be moved is less than 50 meters, the excavation area is divided in half and the tractors work at opposite ends or they work wherever they can, and push the earth onto the roadbed as required.

If the bed is to be raised to a considerable height and dirt is not available along the sides of the route, it is sought in the neighboring vicinity. The same method is used for roadbed construction in swampy areas.

In actual practice, roadbed construction in swampy areas was not always easy. Tractors had difficulty operating there because the earth would not support their weight. Special measures, such as building special embankments to retain the water on one side and draining the roadbed area by means of special drainage ditches, were necessary. Some time was then permitted to elapse for drying out the roadbed area. Thereupon, the bulldozers used the dried earth for constructing the roadbed, and a permanent drainage ditch was left along the route.

4. Making Cuts

When the earth from cuts could not be utilized for fills, then the cut was carried out by the lateral method. The operation was begun from the center of the route and went first in one direction and then in the other, until the cut attained the necessary depth. When the cut was deep enough, the bulldozer began to push the earth to the ends of the cut. In this case as in general, the cut was made 1 - 2 meters wider than necessary so that the slopes of the cut could be constructed better and faster and did not require any hand labor.

When the earth from cuts was to be used for fills, then the cut was carried out by the longitudinal method. Excavation is carried out in strips, the earth of which is removed one after the other. When all strips have been removed, the tractor cuts the slopes of the cut, knocking the earth to the bottom of the cut. Then the tractor cleans out the cut again, and the operation is finished. The drainage ditches along the roadbed are dug by hand.

Two bulldozers arrived at the Konetsgorskiy Timber Administration on 10 October 1946. In one month's time, from 15 October to 15 November, they had worked 297 machine hours. In this time, they had cleared a route by uprooting or removing natural growth from an area of about 190,000 square meters. About 8,000 cubic meters of heavy earth had been handled in excavation and roadbed construction work.

Bulldozers are effective for earth-moving during the winter, if they are given the proper maintenance. However, the scope of work undertaken should not be too great, so as not to permit the earth to freeze. Any work undertaken should be finished the same day or at the latest on the second day.

In January 1947, the bulldozers of the timber administration worked 300 machine hours. During this month, they cleared routes, uprooted stumps, made excavations, and built embankments.

This experience shows that bulldozers can be utilized successfully in winter or summer and that construction of narrow- and wide-gauge railroads can be carried on no matter what the soil is like.

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